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Case Series: Embolic pneumonia in adult dairy cattle associated with udder cleft dermatitis. Four cases on one high yielding dairy farm.

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Udder cleft dermatitis (UCD) is also known as bovine ulcerative mammary dermatitis, foul udder, udder rot, and intertrigo. It is described as a malodorous and ulcerative lesion located mainly between the anterior udder and the abdomen but can also be found between the two fore quarters. It has been recognised in numerous countries and has been reported over a number of years (Boyer and Singleton 1998, Beattie and Taylor 2000, Warnick and others 2002, Olde Riekerink and others 2014, Persson Waller and others 2014, Bouma and others 2016, Turner and others 2017, Ekman and others 2018).

Udder cleft dermatitis lesions are generally not considered to cause systemic illness in themselves though they have been reported to increase the risk of clinical mastitis (Persson Waller and others 2014) and have been reported to cause rupture of the adjacent milk vein and severe blood loss (Warnick and others 2002). Although documented in literature, little is known regarding the prevalence of, and risk factors for UCD. Several individual cow risk factors have been associated with increased UCD, such as milk production level, udder fore quarter size, small angle of udder to body wall, and udder depth (Olde Riekerink and others 2014, Persson Waller and others 2014, Ekman and others 2018) along with herd level risk factors of milk production, increasing parity, and days in milk (Persson Waller and others 2014, Bouma and others 2016, Ekman and others 2018); Warnick and others (2002). Occurrence of digital dermatitis on the farm, or ectoparasites have been suggested to be associated with UCD however not proven and casual organisms have not been identified (Warnick and others 2002, Stamm and others 2009, Evans and others 2010, Persson Waller and others 2014).

The prevalence of UCD is generally higher than perceived by farmers and veterinarians, possibly as it can be difficult to detect due to the anatomical position and the fact that cows seldom show general signs of disease. One Swedish study found 98 out of 99 randomly selected farms had a UCD lesion with prevalence ranging from 0 to 62% of cows and an average prevalence of 28% (Ekman and others 2018). A Dutch study found 80% of 20 randomly selected herds had cows affected with UCD (Olde Riekerink and others 2014) with variation in prevalence from 0 to 15% of cows (Olde Riekerink and others 2014, Persson Waller and others 2014).

This report details a case series of four adult lactating Holstein dairy cows from the same farm presented over a 2-year period with UCD lesions that progressed to fatal embolic pneumonia. To the authors' knowledge these cases, two of which were initially reported by colleagues (Turner and others 2017), are the first reported cases of UCD infection that have resulted in haematogenous spread of infection and subsequent death of the affected animals. Discussion of the cases with colleagues at the Animal and Plant Health Agency (APHA) has highlighted a further small number of cases reported in the south-west of England (Millar and others 2017).

The farm has a 220 cow Holstein dairy herd with an average 305-day yield of approx. 11,000 kg. The herd is milked 3x a day through a herringbone parlour. The herd is housed all year round in sand cubicles and are run as two groups, high yielders and low yielders. Dry cows are also housed on sand, in cubicles during the far-off period and in yards at transition. The herd is endemically infected with digital dermatitis and interdigital necrobacillosis, and foot bathed five times a week in 3% formalin to control these diseases. Regular mobility scoring of the herd reveals good foot health with prevalence of lameness ranging from 3 to 13% during the past 2 years. Lesions of UCD are recognised and treated by farm staff and, veterinary advice had not been sourced prior to presentation. Mange has also been diagnosed in the herd although species identification has not been achieved.

The cases all presented between February 2016 and December 2017. All four cows were between 52 to 204 days in milk when initially presented. The cows were in their 2nd, 3rd, 4th, and 5th lactations. The somatic cell count within one month of presentation ranged from 16,000 to 190,000 cells/ml. Three cows had active UCD lesions and one had an aged lesion. Presenting signs all included malaise, milk drop and dyspnoea. Clinical examination and diagnostic tests led to an initial diagnosis of chronic suppurative pneumonia. The cases responded poorly to antibiotic treatment and died or were euthanised between one and 18 days after initial presentation.

Post Mortem examination of these cows revealed UCD lesions with areas of fibrous and thickened cutaneous and subcutaneous tissues of the adjacent body wall as well as multiple abscesses containing dark brown material. Haematogenous and lymphatic dissemination of the infection resulted in enlarged and oedematous

lymph nodes, with the supramammary lymph node particularly affected. All animals had pleuritis and variable sized poorly demarcated abscesses containing necrotic foul-smelling material throughout the lungs. Heart lesions were also found including endocarditis and pericarditis. Bacterial culture of organisms isolated from the skin and lung was performed in two of the cows. Cow 1 cultured *Providencia stuartii*, a facultative anaerobic bacterium which is considered to be an opportunistic pathogen in this case. Cow 2 cultured *Trueperella pyogenes*, *Proteus* spp. and *Fusobacterium necrophorum*.

It is crucial that farm animal veterinarians and pathologists are made aware of this newly recognised aetiology of embolic pneumonia and sepsis secondary to UCD, of which numerous cases have now been diagnosed. Increased awareness will result in better recognition of such cases, and thus allow more appropriate and timely interventions to be made. Producers should also be aware that what may be considered a minor superficial lesion on or adjacent to the udder can have severe consequences, and further research into this commonly recognised but poorly understood disease is indicated.

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